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USE OF FREEZE-DRYING FOR THE RECOVERY OF WATER-DAMAGED DOCUMENTS

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The use of evaporative freeze-drying has been investigated in this work as an efficient technique for the restoration of water-damaged papers and archive materials. The present work has the following aims:

- 1) setting a standard and reproducible method to prepare soaked and homogeneous samples; this step is necessary to assess the validity of the proposed procedure and has been quite often neglected in the past works in this field;
- 2) setting an experimental approach to analyse the sublimation phase inside the paper sample during the freeze-drying; an innovative procedure for the visualisation of the drying progress has been set up, based on the use of a liposoluble dye, evidencing the geometry of the ice core, whose volume decreases towards the sample core during freeze-drying. This allowed to validate the model predictions of the time evolution of the ice core volume.
- 3) applying freeze-drying (in a lab-scale apparatus, which allowed to monitor the temperature as well the weight of the samples) to water-soaked samples to restore the dried condition;

The final goal of this work is then to develop a simple mathematical model able to predict the time evolution of the moisture content in the sample. Experimental results have been successfully compared to the predictions of a simple phenomenological model, thus allowing the optimisation of the operation and the minimisation of the duration of the process.